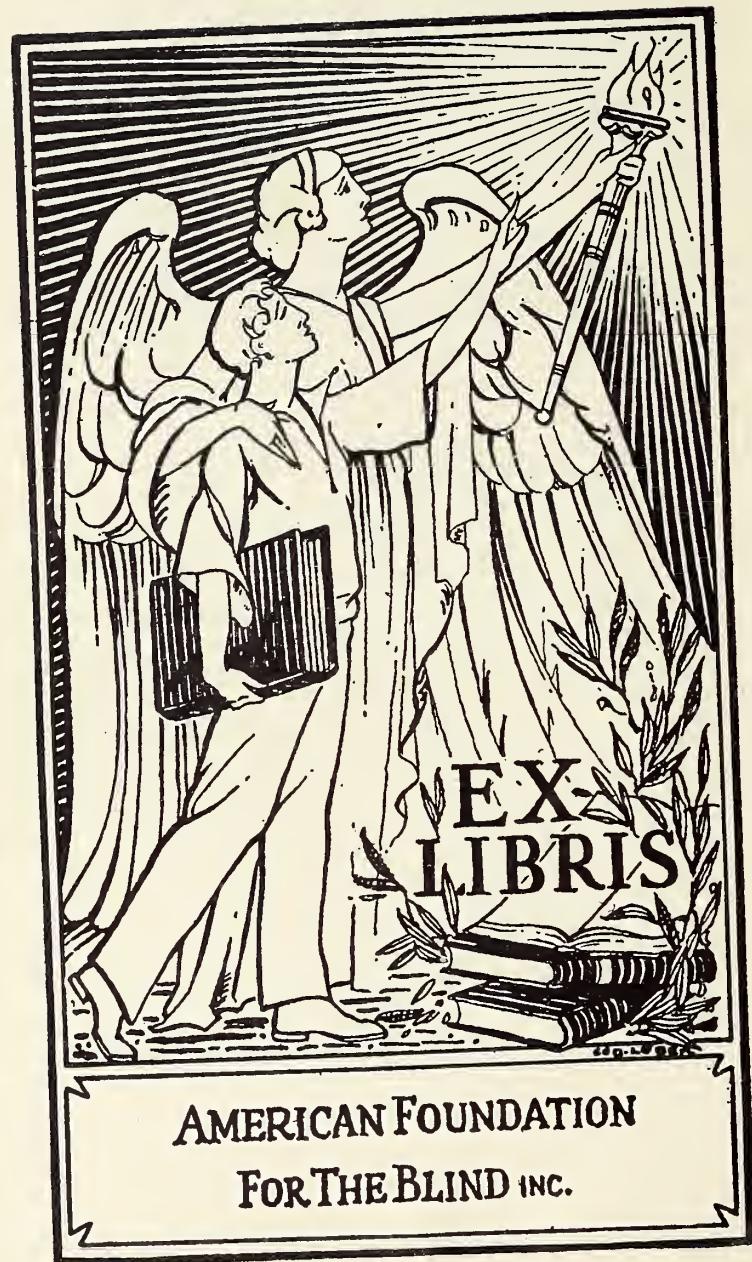


vision screening of children

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IMPORTANCE OF VISION SCREENING

IMPAIRED VISION in children can seriously impede learning and contribute to the development of emotional and behavior problems. If vision defects are discovered and treated early, however, serious impairment and its consequences can often be prevented. In recent years a considerable amount of knowledge has accumulated on vision problems and their early detection through vision screening. This report summarizes the main principles, problems, and methods in vision screening and briefly reviews the estimated prevalence of eye problems among children.

Unlike adults, children with impaired vision are often unaware of their handicap and so do not complain or seek help. It is up to the adults responsible for their health care and supervision to uncover these problems. Ideally, each child should have a professional eye examination in infancy and at regular intervals thereafter throughout childhood. But lack of public awareness of the value of such examinations, insufficient trained personnel, and the high cost of professional care are some reasons why this goal is more ideal than practical.

Vision screening is less satisfactory but it will identify children who are in need of professional eye care. Screening of preschool children is especially important because amblyopia ("lazy-eye blindness"), which is reported to occur in 1-6 percent of children,³³ can often be prevented if the condition is detected and treated in the first years of life.

Screening activities have expanded considerably, particularly in regard to preschool children, for whom there was little screening being done a few years ago. Vision screening in the Head Start projects, for example, means many more thousands of children are being reached (about 650,000 children were in Head Start in 1968, of whom most were screened for visual acuity). Preschool screening programs that are reported to the National Society for Prevention of Blindness have been growing rapidly (from 86 projects screening 52,000 children in 1963-64 to 289 projects screening 156,000 children in 1965-66). Nevertheless, in relation to the total 3- to 6-year-old population, it would appear that only a small fraction is being screened.

Vision tests should be a part of the periodic physical examination, and

vision screening should be incorporated into any program undertaking the total health care of children. Vision screening should also be conducted in those places where children can be reached as captive groups, such as day care centers, nursery schools, and elementary and high schools.

When vision screening programs are established in a community, every effort should be made to call the public's attention to their existence and to encourage their use. It is also important that the difference between a professional eye examination and a vision screening test be explained to the parents of children tested. Parents should be instructed to seek professional help whenever they have any doubt about their children's vision, regardless of how recently the child has had a vision screening test with normal results.

PREVALENCE AND TYPES OF VISION PROBLEMS

A SURVEY by Crane et al. in St. Louis⁹ found that 27 percent of the school children had eye problems which required treatment or observation. On the basis of this study, the Children's Bureau estimated that, in 1960, 10,200,000 children between 5-17 years of age had eye conditions requiring special care. The number projected for 1970 is 12,500,000.⁴⁸

The prevalence of visual problems among preschool children is more difficult to determine, for there has been no entirely satisfactory means of screening children in this age group, and what constitutes normal vision in the preschool years has remained to some extent a controversial subject. The rate of referrals from various screening programs among preschool children ranges from 1 to 30 percent.^{24 34}

Of the 156,252 preschool children who were screened during July 1965-June 1966 in projects reported to the National Society for the Prevention of Blindness, more than 8,700, or about 5.5 percent, were referred for professional eye care. Analysis of the results of professional examinations of the children referred from 109 projects revealed that 75 percent of those examined were in need of eye care, giving a defect rate of 29 per 1,000 screened. Of the children for whom a specific abnormal condition was reported, refractive errors were diagnosed in 87 percent, muscle imbalance in 22 percent, and amblyopia in 11 percent. Since these findings are based on incomplete reporting of results, they probably underestimate the proportion of preschool children with visual problems.¹⁴ The rapidly expanding vision screening programs for preschool children should result in better knowledge about vision in this age group.

Visual problems are more prevalent among older children than among younger children. In the St. Louis study, 31 percent of the sixth grade students required eye care or observation, while only 23 percent of the first grade students needed such attention. In the Orinda (Calif.) study visual problems were found in 18 percent of the children between 5 and 7 years of age and in 31 percent of the 13-15-year-old-group.²⁷ Partially seeing children, defined as those with a visual acuity of 20/70 or less in the better eye after the best correction possible, are estimated to number 1 in 500 in both the preschool and school-age groups. Children who are legally blind (defined as visual acuity of 20/200 or less in the better eye after correction, or acuity better than 20/200 but visual field in the better eye restricted to less than 20 degrees in the widest diameter)

number about 1 in 8,000 in the preschool group and 1 in 1,400 in the school-age group.³

The two major correctable visual defects among preschool and school age children in the United States are refractive errors and muscle imbalance, both of which are considered causative factors of amblyopia.^{9 14} In the St. Louis study, refractive errors were found in 20.5 percent of the children examined (hypermetropia, hypermetropic astigmatism or both in 12.3 percent, and myopia or myopic astigmatism or both in 8.2 percent), and muscle imbalance in 4.4 percent.⁹

Visual defects are reported to occur more frequently among children with mental retardation, cerebral palsy, or hearing loss, and among children of low socioeconomic levels. Fletcher et al. reported that 76 percent of 102 mentally retarded children who were given a complete eye examination had abnormal findings.¹² The rate of referral in a vision screening program conducted by the Michigan Health Department among a group of mentally retarded children was three times that found among regular classroom children.¹⁹ In a group of 98 children with cerebral palsy, age 4 to 10 years, Schachat et al. found that 68 percent had either an ocular defect or a refractive error, or both.³⁵ Suchman reported that 58 percent of a group of 103 children with impaired hearing had some visual abnormality.⁴⁴ Of considerable significance is the fact that although 90 percent of the visual defects found in this group of children were considered correctable by the authors, 87 percent were not even partially corrected. A study conducted by the Michigan Health Department indicated that children from low socioeconomic areas have twice as many visual defects as children from high socioeconomic areas.^{6 18}

Defective color vision, which is hereditary in most cases, occurs with much greater frequency among boys than girls in the general population. The reported prevalence varies considerably among the surveys. According to "Services for Children with Eye Problems" published by the American Public Health Association,³ about 8 percent of boys and one-half of 1 percent of girls in the average school population have evidence of defective color vision. Higher and lower figures have been quoted by other sources. Color blindness varies with race; for example, red-and-green blindness is reported by Pickford to be more frequent among whites than among Negroes.²⁸

Until recently the prevalence of color blindness and the male-female ratio of cases were thought to be the same for the mentally retarded as for the general population. Studies now indicate a substantially higher prevalence in the retarded and a nearly even male-female ratio among the cases.³⁶ It is possible, however, that the higher rate found among the retarded derives from their difficulty in comprehending the test and in following the directions, and further studies are needed of this question.

BASIC PRINCIPLES OF VISION SCREENING PROGRAMS

Purpose and scope

The main purpose of a vision screening program is to identify children who are in need of special eye care and to refer them for diagnosis and therapy.

Although it is not included in the definition of screening per se and not discussed here in detail, a referral system through which children who are found to require eye care can be properly channeled should be included in all vision screening programs. Of equal importance is a followup system to ensure that recommendations made for children who need eye care are carried out. Followup will also indicate the efficiency of the screening procedures in terms of the number of over-referrals and under-referrals. A vision screening program which does not include referral and followup procedures cannot be considered complete, for without them much of the effort directed at screening will be wasted.

Vision screening procedures should thus be regarded only as part of an overall program, the ultimate aim of which is the provision of complete diagnostic and therapeutic eye care services for those who need them.

Components of screening

Vision screening should consist of two parts: screening by clinical history and screening by vision test or tests.

Clinical history. A carefully taken history will often provide invaluable clues to the diagnosis of visual problems in children. The Michigan Health Department reported that half of the preschool children who failed its vision screening tests had either a family history of eye disease or clinical signs or symptoms suggestive of eye problems.⁵ Yet clinical history is sometimes overlooked as part of a screening program. While histories taken by trained personnel may be more accurate, where this is not feasible questionnaires may be distributed to parents to be answered before vision screening tests are conducted.

Clinical histories which include any of the following circumstances would classify a child as high risk: (1) family history of visual defects

such as defective color vision, refractive errors, strabismus, and congenital cataract, of inborn errors of metabolism like diabetes, galactosemia, lipidoses, albinism, and retinoblastoma; (2) a history during pregnancy of the mother of rubella, toxoplasmosis, syphilis, or toxemia; (3) birth history of prolonged or difficult labor or low birth weight; (4) difficulties in the neonatal period, particularly respiratory difficulty which required prolonged oxygen therapy; and (5) evidence of mental retardation, deafness, or cerebral palsy.³⁷

Complaints such as frequent headaches, dizziness, sensitivity to light, and blurred vision, or actual signs such as crossed eyes, eyes turned out, constant rapid movements of the eyes (nystagmus), red, swollen, or encrusted eyelids, watery eyes or discharges, haziness in the pupils, etc., should of course be given professional attention.

Certain types of behavior are suggestive of visual problems: holding books unusually close to or far from the eyes while reading, frequent blinking, squinting, or rubbing of the eyes, abnormal head tilting or turning, inattention in blackboard, wall-chart or map lessons, poor alignment in written work, unusual choice of colors in art work, confusion of certain letters of the alphabet in reading such as o's and a's, e's and c's, b's and h's, n's and r's, inability or reluctance to participate in games requiring distance vision or visual accuracy, irritability when doing close work, or difficulty in doing work which requires visual accuracy, etc.^{3,20} Teacher observations are often valuable and should be included in the history if available.

Vision testing. Theoretically, many components of the visual sense should be tested—central visual acuity (distance and near), peripheral vision, binocular vision, color sense, etc. However, procedures which cover numerous visual components are too time-consuming and complicated to be practical for mass application. Many authorities agree that a test for central distance visual acuity is the single most important test of visual ability in children.^{23,42} Programs based on this test have identified more children in need of eye care than those based on any other vision test.²³ This test and a clinical history should be considered the basic *minimum* procedures in any screening program. Whenever possible, tests for accommodative ability, muscle balance, and color vision should also be given. It should be noted, however, that tests of accommodative ability are considered by some to be not very useful for the early years of childhood, when almost all children have great powers of accommodation and are characteristically still somewhat hyperopic. The investigators in the Orinda study concluded that the Modified Clinical Technique was the most accurate means of screening. However, this technique consists of a battery of tests ("visual acuity, objective estimate of refractive error by means of skiametry and lens bar with motion-picture cartoon

for fixation, cover test far and near, observation and internal examination for pathology and anomalies if indicated" ⁷) that must be administered by professional examiners.

To be applicable as a screening procedure, a vision test should be relatively simple so that it can be reliably administered by nonprofessional personnel after appropriate training and supervised practice. The test should not be time-consuming, since a relatively large population is to be screened within a short period of time. It must nevertheless be sufficiently sensitive so that neither over-referrals nor under-referrals occur with undue frequency, although some such referrals are unavoidable. Between over-referrals and under-referrals, the latter have a more serious implication. On the other hand, too many over-referrals are likely to diminish public confidence in such screening programs and result in poor co-operation. In order to reduce the number of over-referrals, it has been suggested that children who do not pass a vision screening test be retested on another day, and that only those who fail the screening test twice be referred. Spot checks of the screening might be done by an optometrist or ophthalmologist acting as consultant for the program. Lastly, equipment used in screening should be relatively inexpensive and simple. In short, vision screening tests should be reasonably accurate and yet permit economy in manpower, time, and money.

Schedule for screening

Although it is desirable that screening programs provide each child with a thorough vision screening every year, this is often not possible. It has therefore been suggested that each child be given the basic minimum screening procedure once a year, and a more comprehensive screening every 2 or 3 years. Where a lack of resources makes such a schedule impossible, a schedule aimed at screening children during certain critical periods may have to be adopted. After an initial screening in the preschool years, the children should be tested again at 9-10 years of age because refraction in many school children gradually changes from slight hyperopia to myopia at this age, and the rate of referral in most school screening programs increases abruptly at the fifth grade level.¹⁷ Adolescence, a time of rapid growth and development, is another period when vision screening should be done.⁴³ Color vision should be tested, preferably in the preschool years, but at least before the end of the intermediate grades (4th to 6th).^{3,23} Although defective color vision is not correctable, those affected should be aware of their limitation. Awareness of the defect is especially important when children begin considering occupations to prepare for.

TESTS FOR SCHOOL CHILDREN

Basic test

The standard Snellen Test is the procedure most commonly used in screening central distance visual acuity of school-age children. It is also applicable among younger children who are literate. The wide acceptance of this test as the basic minimum test is well supported by studies which indicate that it surpasses comparable screening procedures not only in detecting the largest number of children requiring eye care, but also in producing the highest percentage of correct referrals.^{9,13} The procedure is well standardized and needs no elaboration here. A practical criterion for referral with this test is acuity of 20/40 or less in either eye for children in kindergarten through the third grade, and 20/30 or less for those in the fourth grade and above.²³

More comprehensive screening

Where feasible, screening which is more comprehensive than that afforded by the basic minimum procedure should be done. For this purpose, the Massachusetts Vision Test and its modified versions appear to have gained wide acceptance. In the St. Louis study reported by Crane et al., the results of various vision screening procedures (the Snellen Test, the Massachusetts Vision Test, teacher judgment, a near vision test using the Lebensohn or Guibor Charts, the Keystone Telebinocular Test, the Bausch and Lomb Ortho-Rater, the American Optical Company Sight-Screener, and a combination of screening procedures*) were compared with the findings of an ophthalmologist.⁹ The comparison indicated that while none of the procedures was entirely satisfactory, the Massachusetts Vision Test and the Snellen Test correlated best with the ophthalmological examination and were the least inefficient.

* Trade names are used in this report to provide specific information; their use does not imply endorsement by the author or the Maternal and Child Health Service.

The original Massachusetts Vision Test introduced in 1940 consists of three parts:⁴⁰

1. Test for visual acuity with the Snellen E chart.
2. Test for latent hyperopia (accommodative ability) with a plus lens.
3. Test for muscle imbalance with the Maddox rod.

The National Society for the Prevention of Blindness recommends that for the plus lens test for accommodative ability, a +2.25 diopter lens be used for children in the first three grades and a +1.75 for those in the fourth grade and above. The ability to see the 20-foot line at 20 feet from the chart with either eye while wearing these lenses constitutes failure for this test, for it suggests that the child probably has as much hyperopia as represented by the lens, or more. The criteria for referral suggested for the muscle balance test are as follows: for outward or lateral deviation (exophoria or exotropia), more than four prism diopters for a 20-foot distance and eight prism diopters for a near object; for inward deviation (esophoria or esotropia), six prism diopters for either distant or near objects. For vertical deviations, the criterion for referral is more than one-and-a-quarter prism diopters.²³

Color vision is generally tested with sets of pseudoisochromatic plates, as in the Ishihara Test and the Hardy-Rand Rittler Test. Proper illumination is essential in testing color vision, and the Source C Macbeth Easel Lamp is recommended.²³

The American Optometric Association recommends the following tests for preschool through second grade: visual acuity at distance, 6 diopter prism test for binocular awareness, +1.50 sphere test for hyperopia, Polaroid Fly test for binocular awareness at near. For grades 3 through 12, the Association recommends the following tests with a standard stereoscopic device: at distance—vertical phoria, lateral phoria, fusion, visual acuity (monocular and binocular), +1.50 sphere test, depth perception, color discrimination; at near—lateral phoria, fusion, visual acuity (monocular and binocular).²

SCREENING CHILDREN OF PRESCHOOL AGE

VISION SCREENING of preschool children, particularly those under 3, presents certain problems not generally encountered among older children. But with public education, community support, careful selection, training, and supervision of screening personnel, and preparation of the children for testing procedures, vision screening programs for preschool children can be successful.

Awareness and understanding of the problems that one may encounter in screening preschool children are important to developing a successful screening program. The following discussion is intended to provide the reader with a better insight into some of the problems, and to offer some suggestions for handling them.

Special problems

Limited attention span and easy distractibility. Young children generally are easily distracted. Because vision tests for young children are designed to be attractive to them, test materials themselves sometimes become a source of distraction, and some children are more interested in playing with the test materials (such as toys and pictures) than in following the test procedure. Testing of the two eyes separately, which is essential in detecting amblyopia, may be difficult because some children are unwilling to have one eye covered. This may be remedied by having the child look through a peephole or by using some interesting device, such as a black "pirate's patch," to cover one eye. Occasionally, very young children may not be able to concentrate long enough to perform the same procedure twice, once for each eye, and repeat testing on another day may be necessary. Testing for distance vision at the standard 20-foot distance is sometimes unsuccessful because at such a distance young children may lose contact with the tester. This problem can be remedied by adequate prior preparation of the children, or by placing a mirror at a distance of 10 feet.³³

Other factors affecting test performance. Many tests have been devised for screening visual acuity in young or illiterate children. Most are subjective; there is no satisfactory objective test that can be administered by nonprofessional testers at present. Performance in almost all the subjective tests depends either on the child's ability to distinguish directions or on his

ability to recognize forms and shapes as presented in pictures or objects. Certain tests for muscle balance also involve the concepts of number and color. In addition, a child must be able to convey to the tester what he perceives, either verbally or manually.

The age at which children become mature enough for subjective vision tests varies considerably. Most, however, can be reliably tested by age 4. Some children, particularly those with learning disabilities, continue to confuse spatial relationships even in late preschool or early school years as evidenced by mirror-image reading and writing ("b" as "d," "p" as "q," "was" as "saw," etc.). Others find it difficult to convey correctly to the tester the direction perceived. This is particularly true when young children are asked to indicate manually the horizontal positions. Some right-handed children are unable to turn their right hands toward the right but can turn toward the left, and vice versa for left-handed children.^{15,33} Testers should be aware of this possibility and request response by other methods whenever such difficulty is suspected.

Performance is also easily affected by physical or emotional disturbances such as hunger, fatigue, boredom, and fear or uneasiness at being in a strange environment or being confronted with a strange person. Testers should be reassuring and never show impatience with children who are slow in responding.

It has been observed that untestability is more common among children from low-income, or "culturally deprived," families.¹⁶

Interpretation of the results for young children should take into consideration all these factors and in many cases may prove difficult. To minimize over-referrals, preschool children who fail in a screening procedure should be retested on another day before they are referred. It has also been suggested that children who do not respond to a particular test be retested with a different test.

Lack of agreement on what constitutes normal vision among preschool children. Sheridan and Pugmire in England state that normal visual acuity by 5 years of age should be 20/20.³⁰ But others contend that preschool children are normally hyperopic, and those who see 20/20 before age 6 are abnormal and may become myopic later in childhood.⁴ The National Society for the Prevention of Blindness recommends a referral level of 20/50 for 3-year-olds, and 20/40 for 4- and 5-year-olds. A difference in visual acuity of the two eyes, if confirmed twice, is an indication for referral, even if the individual scores for the eyes are within the passing standard.

Similarly, in tests for hyperopia, some maintain that any deviation less than 3.75 diopters does not warrant special eye care while others consider 1.5 diopters of hyperopia a valid reason for referral.^{7,40} The Advisory Committee for Vision Screening of Children of the National Society

for the Prevention of Blindness recommends that tests for hyperopia not be given to preschool children since this can lead to excessive over-referrals. Thus what is regarded as a justified referral by some may be criticized by others as altogether unnecessary.

In addition to these difficulties, preschool children, unlike children in school, are not a captive group and are not easily reached by vision screening programs. But with sufficient interest and support from the community, these children can be located and screened.

Because of the many difficulties encountered in testing young children, it has been suggested that vision screening be limited to a clinical history and test of visual acuity in the preschool years, to be followed by more extensive tests in the school years.⁴² Some prefer to include simple tests for muscle balance, such as the Hirschberg test or the cover test, even in the preschool years.⁴¹ The cover test, however, has been found by other users to be unreliable as a screening procedure, even in the hands of well-trained examiners.⁴⁵

Recently Taubenhaus and Jackson carefully compared results of four visual acuity screening tests (the Snellen E test, the Allen Picture Cards, the Sjogren Hand, and the Titmus Screener, which utilizes the Michigan Junior Vision Screening Test in a stereoscopic instrument) with the findings of two ophthalmologists for a group of 4,067 children 3 to 5 years old.⁴⁵ They concluded that all four visual acuity tests were roughly equivalent and sufficiently reliable, and that the major factor in a preschool vision screening program is not what test to use, but the training given to the persons doing the testing.

Clearly the efficiency of a screening program is affected by many factors other than the sensitivity of the test itself. These include the training of the testers, the testers' understanding of growth and development, their ability to work with young children, and preparation of the children for the test procedure. It is essential that testers be given training and supervised practice before they are permitted to conduct actual screening.

Tests of visual acuity in preschool children

The following tests of visual acuity have been reported to be useful in screening preschool children. Tests which are considered unfit for large-scale application are not included.

1. Tests based on a child's ability to distinguish directions

A. *Snellen E Test*²⁰

This is the most widely used and best standardized test for vision screening of preschool children. It is generally suc-

cessful with 4- and 5-year-olds. The test is frequently unreliable with children 3 years and under, partly because of their undeveloped sense of direction.³³

The letter E is presented with its arms facing in one of four directions (left, right, up, down), and the child is asked either to name the direction in which the arms of the letter point or to hold his hands or a cut-out letter E in comparable positions. To facilitate perception of this abstract symbol by the young child, the letter E is often referred to as a "table" and its arms as "legs of the table." The screening should be conducted as a game rather than as a test, otherwise young children may find the procedure monotonous and uninteresting.

B. *Sjogren Hand Test* ³⁹

This test is basically the same as the Snellen E Test. A hand with extended fingers is used instead of the letter E. It is more interesting than the Snellen E chart to young children, but, according to Sheridan, it is less reliable since the large "blob" representing the palm seems to provide additional clues for correct guessing.³⁷

C. *Landolt Broken Ring Test* ²⁶

Broken rings constructed on the same basis as the Snellen charts with regard to size and visual angle are presented to the child who is asked to indicate the point at which each ring is broken. This test is subject to the same criticism as the Snellen E test.

D. *California Clown Test (Do-As-I-Do Vision Test)* ^{33,38}

This test was designed by Dr. W. T. Simpson and used originally in California. The device for the test consists of a large colorful clown with a circular opening at the waist which is illuminated from the rear. A stylized clown's hand which is made in different sizes corresponding to the Snellen E chart is presented at the opening. The position of the clown's hand is changed by dialing a disc behind the clown and the child is asked to imitate with his hand the position of the "Do-As-I-Do" clown's hand. The device has also been adapted to screen for fusion and color vision.³⁸ While the test is very appealing to children, development of the sense of direction is still a prerequisite to successful testing.

E. *Michigan Junior Vision Screening Test* ^{5,19}

The test chart has a movable E in the center and four simple

pictures which serve as reference points. The E is turned so that the "legs" alternately point to each of the four pictures, and the child indicates the position of the letter E by identifying the picture pointed to. A modification of the original test chart uses four rows of E rather than a single letter. Training cards similar to the screening instrument are available, and may be distributed to parents beforehand to familiarize children with the test procedure. This test overcomes the confusion of spatial relationships common among young children by using pictures as reference points and appears to be a very promising screening test for young preschool children. The Michigan State Health Department reports successful screening of 3- and 4-year-olds with this procedure.

2. Tests based on a child's ability to recognize forms and shapes

A. *Matching letter tests*

Children can match similar letters at an appreciably earlier age than they can draw them. This fact is the basis for testing vision in young children with letter-matching tests. The child is asked to match the letter presented to him by pointing to the same letter on a key card which he holds, or by placing a coin over the letter on the card; he may draw the letter if he is capable of doing so.

At least three such tests have been devised; all are based on the same principle and use the same group of letters. They are the Stycar Test (Screening Test for Young Children and Retardates) from Great Britain,³⁷ the Lotto Test from France⁷ and the Holt Test from the United States.¹⁵

For the very young (2-3-year-olds), a group of five letters are used for matching: O,V,X,T,H. For the older preschool children (4 years and older), seven letters are used for matching (A and U are added); sometimes nine letters are used (C and L added). According to Sheridan, who devised the Stycar Test, some 2-year-olds can match five letters, though others confuse X and V. Three-year-olds generally can match five letters and some are capable of matching seven letters. The average 4-year-old can match seven letters and sometimes nine letters.³⁷ In a study conducted among children between 32 to 54 months of age, Savitz et al. report that in general the children did not find this test attractive, and only 44 percent of 59 children were considered testable.³³ Lippmann on the other hand found that Stycar could be used successfully with most children that he tested.¹⁶

B. Picture tests

Several such tests have been designed for testing visual acuity in young children. Objects familiar to children are drawn somewhat schematically, black on white. The most commonly used picture tests are: The Osterberg Chart from Denmark ²⁵ (swan, steamboat, house, man, car, horse, train, skeleton, key, horse and wagon, scissors, plane, Christmas tree, man on bicycle), the Allen Picture Cards ¹ (teddy bear, plant, flower, clown, birthday cake, Christmas tree, steamboat, telephone, and horse with rider), and the American Optical Kindergarten Chart ³³ (sailboat, circle and cross, flag, star, heart, cross, moon, cup and hand). These tests are generally attractive to children, but lack of experience with the objects represented by the pictures, or inability to translate a two-dimensional and highly stylized black and white pictorial representation into the corresponding three-dimensional multicolor object sometimes interferes with the success of these tests.

C. Symbol Test

To circumvent the obstacles presented by vision tests which involve the sense of direction or ability to recognize abstract pictures, this test uses three symbols, the square, circle and triangle, reproduced according to Snellen sizes. These symbols are among the first shapes recognized by young children so that testing at an early age is said to be possible.¹¹ Some add a diamond or cross.¹⁵ This test is basically like the letter-matching test.

D. Miniature Toy Test

This test was designed by Sheridan of England for the very young, i.e., those between 20 months and 3 years, and severely handicapped children who cannot be tested with the Stycar letter-matching test.^{33,36} The child is asked to identify a set of miniature toys (car, plane, doll, chair, knife, fork and spoon), each about 2 inches high, placed at a distance of 10 feet.

The child identifies the toy by either naming it or matching it with a duplicate set. There is no numerical Snellen equivalent for this test. The best acuity detectable by this test is the ability to distinguish a small fork from a small spoon at 10 feet, which is said to approximate a vision of 20/20. This test is very appealing to young children and has been used successfully by Savitz among children under 4 years of age.³³

However, she found that often time is lost from dawdling with the toys, and Lippmann concluded that the test was impractical because children became upset when they had to give up the toys.¹⁶ It is also difficult, if not impossible, to standardize this test accurately.³³

3. Objective test for visual acuity

A. *Retinoscopy (skiametry)*

In this procedure refractive errors are measured objectively by illuminating the eye with a retinoscope and observing the direction of the movements of the retinal illumination and its bordering shadows when the retinoscope is rotated. In addition to the retinoscope, a pair of +1.50 diopter lenses in trial frames, a test lens bar and lenses of -0.75, +0.75, +1.50 and +2.25 diopters are needed. A cartoon film projected at a distance of 20 feet may be used to focus children's attention. Retinoscopy has the advantage of permitting objective measurement, and it can be carried out on young illiterate children. However, this procedure can be done only by an optometrist or ophthalmologist.

B. *Test based on optokinetic nystagmus*

The optokinetic nystagmus, or "train" nystagmus, occurs when a simple repetitive moving pattern, such as vertical lines moving horizontally, is viewed. In a test for visual acuity, the width and separation of vertical lines used as the stimulus may be graded and the stimulus presented at various distances. In general, this test has not found wide acceptance in clinical application nor has it been well standardized as a vision screening test for preschool children.^{26,31,32} After a careful study of the optokinetic nystagmus in infants and young children, Savitz concluded that a test based on this reflex has little advantage over a good history as a vision screening procedure.³²

Screening of preschool children by their parents

It is in the preschool years that diagnosis and treatment of amblyopia can be expected to yield reasonably good results; detection of amblyopia at school age is considered by many to be too late for treatment to be effective. Because of the difficulty of reaching children in the preschool period, the use of a "do-it-yourself" vision screening test which can be

administered at home by parents has been proposed.

Trotter et al. conducted a study among their private patients using an illustrated pamphlet containing isolated E test types and simple directions for testing vision. Among 217 children 3 to 6 years old screened by their parents, the ophthalmologist and parents were in agreement that 183, or 84 percent, of the children had bilateral acuity of 20/30 or better. Six children, or 3 percent, were considered false referrals. Among 16 children found by the ophthalmologist to have a visual acuity of 20/40 or worse, only 8 were discovered by parents in their screening.

The Illinois Chapter of the American Academy of Pediatrics together with the Illinois Department of Public Health and the Chicago Medical Society recently developed a modified Sjogren hand card to be administered by parents to their 3- to 5-year-old children. Children are asked to point their hands in the same direction as the hand pictured on the card at a distance of 3 feet and again at 12 feet.⁴⁷ Among 1,288 children screened by their parents with this card, 97, or 7.5 percent, were reported to have failed. Of these, 37, or 2.9 percent, of the overall number were found to be correct referrals on followup examination. There was no report on the number of children with defective vision who were missed by this parent-administered screening procedure.²⁹

Although these preliminary studies suggest that do-it-yourself vision screening tests are feasible, one should interpret these results with due reservation since these surveys were conducted among private patients; the results may not be duplicated in a different population. Parents administering such tests should be warned of their limitations and instructed to seek professional help if visual defect is suspected, whether or not the child passes the parent-administered test. These tests have potential value in areas where vision screening programs for preschool children do not exist, and for individual children who cannot be reached by screening programs until after they enter school.

NEED FOR COOPERATIVE EFFORT AND PUBLIC EDUCATION

A SUCCESSFUL large-scale vision screening program for children requires the coordinated effort of ophthalmologists, optometrists, pediatricians, nurses, social workers, school authorities, teachers, public educators, interested public and voluntary agencies and groups such as local health departments, education departments, and PTA's. The various professions and groups will need to work together in planning screening programs that will be readily available to all children in the community. Attention must be given not only to the actual screening procedures, but also to careful selection and training of the testers, preparation of the public for such a program beforehand, and adequate followup of children referred for diagnosis.

The public, particularly parents, should be made aware of the fact that all children should be tested periodically, regardless of whether signs of possible visual problems are present or not. The importance of early diagnosis of visual defects should be explained. The public's attention should be called to the existence of vision screening programs in the community, and the purpose, meaning, and limitations of these programs should be made clear. Parents and others should be acquainted with the common signs and symptoms of visual problems, and be advised to seek help whenever suspicions of such problems arise, even if the children have just passed a vision screening test. Dissemination of information on what circumstances indicate high risk insofar as vision is concerned will further increase their index of suspicion.

With improved organized effort directed toward large-scale vision screening and increased public interest in such programs, we can expect significant reduction among children of vision loss and impairment from preventable causes.

REFERENCES

1. Allen, H. F.: A New Picture Series for Preschool Vision Testing. *AMERICAN JOURNAL OF OPHTHALMOLOGY*, 1957, 44, 38-41 (July).
2. American Optometric Association: *VISION SCREENING AND SUBSEQUENT VISION CARE OF THE PRESCHOOL AND SCHOOL CHILD: A PROPOSAL*. St. Louis: The Association, 1965.
3. American Public Health Association, Inc.: *SERVICES FOR CHILDREN WITH EYE PROBLEMS, A GUIDE FOR PUBLIC HEALTH PERSONNEL*. New York: The Association, 1967.
4. Apell, R. J., and Lowry, R. W. Jr.: *PRESCHOOL VISION: TESTS, DIAGNOSIS, GUIDANCE*. St. Louis: The American Optometric Association, Inc., 1959.
5. Blackhurst, R. T.: Successful Preschool Vision Screening in Michigan. *JOURNAL OF THE MICHIGAN STATE MEDICAL SOCIETY*, 1962, 61, 1124-1126 (September).
6. _____, and Radke, E.: School Vision Screening in the State of Michigan. *THE SIGHT-SAVING REVIEW*, 1964, 34, No. 1, 8-15 (spring).
7. Blum, Henrik L., Peters, Henry B., and Bettman, Jerome W.: *VISION SCREENING FOR ELEMENTARY SCHOOLS: THE ORINDA STUDY*. Berkeley and Los Angeles: University of California Press, 1959.
8. Carlevaro, G., and Ouillon, H.: *La Methode Optopsychopedagogique*. *MINERVA MEDICA*, 1958.
9. Crane, M. M., Foote, F. M., Schobee, R. B., Green, E. L., and Price, B.: *SCREENING SCHOOL CHILDREN FOR VISUAL DEFECTS*. Report of a Study Conducted in St. Louis, Missouri, 1948-1949. U.S. Dept. of Health, Education, and Welfare, Social and Rehabilitation Service, Children's Bureau. CB Publication 345. Washington, D.C. (20402): U.S. Government Printing Office, 1959.
10. Davens, E.: The Nationwide Alert to Preschool Vision Screening. *THE SIGHT-SAVING REVIEW*, 1966, 36, No. 1, 13-17 (spring).
11. Fooks, O.: Vision Test for Children, Use of Symbols. *BRITISH JOURNAL OF OPHTHALMOLOGY*, 1965, 49, 312-314 (June).
12. Fletcher, M. C., and Thompson, M. M.: Eye Abnormalities in the Mentally Defective. *AMERICAN JOURNAL OF MENTAL DEFICIENCY*, 1961, 66, No. 2, 242-244 (September).
13. Gutman, E. B.: School Vision Screening. *THE SIGHT-SAVING REVIEW*, 1956, 26, 212-219 (winter).

14. Hatfield, E. M.: Progress in Preschool Vision Screening. *THE SIGHT-SAVING REVIEW* 1967, 37, 191-201.
15. Holt, L. B.: Office Preschool Visual Acuity Testing. *EYE, EAR, NOSE AND THROAT MONTHLY*, 1965, 44, 49-51 (August).
16. Lippmann, O.: Vision of Young Children. *ARCHIVES OF OPHTHALMOLOGY*, 1969, 81, 763-775 (June).
17. Majima, A., Nakajima, A., Ichikawa, H. and Watanabe, M.: Prevalence of Ocular Anomalies Among School Children. *AMERICAN JOURNAL OF OPHTHALMOLOGY*, 1960, 50, 139-146 (July).
18. Michigan Department of Public Health.: Preschool Hearing, Vision Screening Results Revealed. *MICHIGAN MEDICINE*, 1965, 64, 958 (December).
19. _____: *VISION AND HEARING SCREENING IN SELECTED CLASSES FOR THE MENTALLY RETARDED, CITY OF DETROIT, MICHIGAN*. Washington, D.C.: U.S. Dept. of Health, Education, and Welfare, Social and Rehabilitation Service, Children's Bureau, 1966.
20. National Society for the Prevention of Blindness, Inc.: *A GUIDE FOR EYE INSPECTION AND TESTING VISUAL ACUITY*. Publication 200. New York: the Society, 1970.
21. _____: *ESTIMATED STATISTICS ON BLINDNESS AND VISUAL PROBLEMS*. New York: the Society, 1966.
22. _____: *PREVENTION OF BLINDNESS NEWS, 1966 Annual Report Issue*. New York: the Society, 1966.
23. _____: *VISION SCREENING IN SCHOOLS*. Publication 257. New York: the Society, 1961.
24. Oberman, J. W.: Vision Needs of America's Children. *THE SIGHT-SAVING REVIEW*, 1966, 36, No. 4, 217-227 (winter).
25. Osterberg, G.: A Sight-Test Chart for Children. *ACTA OPHTHALMOLOGY*, 1936, 14, 397-405 (January).
26. Parks, M. M.: Technique for Evaluating Vision in Infants and Children. *INTERNATIONAL OPHTHALMOLOGY CLINIC*, 1963, 3, 721-733 (December).
27. Peters, H. B., Blum, H. L., Bettman, J. W., Johnson, F., and Fellows, V.: The Orinda Study. *AMERICAN JOURNAL OF OPTOMETRY*, 1959, 36, 455-469 (September).
28. Pickford, R. W.: The Genetics of Colour Blindness. [In] de Reuck, A.V.S., and Knight, Julie [Editors]: *COLOUR VISION: PHYSIOLOGY AND EXPERIMENTAL PSYCHOLOGY*. Boston: Little, Brown and Co., 1965, pp. 228-248.
29. Press, E., and Austin, E.: Screening of Preschool Children for Amblyopia. Administration of Tests by Parents. *JAMA*, 1968, 204, 767-770 (May 27).

30. Pugmire, G. E., and Sheridan, M. D.: The Visual Acuity of Five-Year-Old Children. *THE MEDICAL OFFICER*, 1960, 103, 177-178 (March).
31. Reinecke, R. D.: Review of Optokinetic Nystagmus. *ARCHIVES OF OPHTHALMOLOGY*, 1961, 65, 609-615 (April).
32. Savitz, R. A.: Personal communication.
33. _____, Reed, R. B., and Valadian, T.: *VISION SCREENING OF THE PRESCHOOL CHILD*. Report of a Study. U.S. Department of Health, Education, and Welfare, Social and Rehabilitation Service, Children's Bureau. CB Publication 414. Washington, D.C. (20402): U.S. Government Printing Office, 1964.
34. _____, Valadian, T., and Reed, R. B.: Vision Screening of Preschool Children at Home. *AMERICAN JOURNAL OF PUBLIC HEALTH*, 1965, 55, 1555-1562 (October).
35. Schachat, W. S., Wallace, H. M., Palmer, M., and Slater, B.: Ophthalmologic Findings in Children with Cerebral Palsy. *PEDIATRICS*, 1957, 19, 623-628 (April).
36. Schein, J. D., and Salvia, J. A.: Color Blindness in Mentally Retarded Children. *EXCEPTIONAL CHILDREN*, 1969, 35, 609-613 (April).
37. Sheridan, M. D.: Vision Tests for Young Children, Normal and Handicapped. *SPASTICS QUARTERLY*, 1962, 11, 25-33 (March).
38. Simpson, W. T.: Personal communication.
39. Sjogren, H.: New Series of Test Cards for Determining Visual Acuity in Children. *ACTA OPHTHALMOLOGY*, 1939, 17, 67-68 (January).
40. Sloane, A. E.: Massachusetts Vision Test: An Improved Method of Testing Eyes of School Children. *ARCHIVES OF OPHTHALMOLOGY*, 1940, 24, 924-939 (November).
41. _____, and Rosenthal, P.: School Vision Testing. *ARCHIVES OF OPHTHALMOLOGY*, 1960, 64, 143-150 (November).
42. _____, and Savitz, R. A.: Vision Screening. *INTERNATIONAL OPHTHALMOLOGY CLINIC* Vol 3, 1963, No. 4, 803-809 (December).
43. _____, and Gallagher, J. R.: Changes in Vision During Adolescence. *AMERICAN JOURNAL OF OPHTHALMOLOGY*, 1950, 33, 1538-1542 (October).
44. Suchman, R. G.: Visual Impairment Among Deaf Children. *AMERICAN JOURNAL OF OPHTHALMOLOGY*, 1967, 77, 18-21 (January).
45. Taubenhau, L. J., and Jackson, A. A.: Final Report. Vision Screening of Three Through Five Year Old Children, 1967.
46. Trotter, R. R., Phillips, R. M., and Shaffer, K.: Measurement of Visual Acuity of Preschool Children by Their Parents. *THE SIGHT-SAVING REVIEW*, 1966, Vol. 36, No. 2, 80-87 (summer).

47. U.S. Department of Health, Education, and Welfare, Public Health Service: Vision Test for 3-5 year-olds. PUBLIC HEALTH REPORTS, 1967, 82, No. 5, 440 (May).
48. U.S. Department of Health, Education, and Welfare, Social and Rehabilitation Service, Children's Bureau: HEALTH OF CHILDREN OF SCHOOL AGE. CB Publication No. 427. Washington, D.C. (20402) : U.S. Government Printing Office, 1964.

EQUIPMENT REFERENCES

Further information on testing equipment mentioned in this report may be obtained from these sources:

A. Tests for screening visual acuity (see part D)

1. Allen Picture Cards (*Preschool Vision Test*)
Ophthalmix Incorporated
Box 102, La Grange, Ill. 60525
2. American Optical Kindergarten Chart
American Optical Company
14 Mechanic Street
Southbridge, Mass. 01550
3. Holt Distance Visual Acuity Screening Cards
The Ophthalmos Division
Ayerst Drug Company
685 Third Avenue
New York, N.Y. 10017
4. Michigan Junior Screener
The Good-Lite Company
7426 W. Madison Street
Forest Park, Ill. 60130
5. Osterberg Chart
Nyrop & Maag
Copenhagen, Denmark
6. Sjogren Hand Test
The House of Vision, Inc.
135-137 N. Wabash Avenue
Chicago, Ill. 60602

7. Snellen Test Charts (*letters and E Symbols*)
National Society for the Prevention of Blindness, Inc.
79 Madison Avenue
New York, N.Y. 10016
8. Stycar Screening Tests
National Foundation for Educational Research in England
London, England

B. Tests for screening color vision (see also part D)

- 1. Hardy-Rand Rittler Pseudoisochromatic Plates
American Optical Company
14 Mechanic Street
Southbridge, Mass. 01550
- 2. Ishihara Test
The Good-Lite Company
7426 W. Madison Street
Forest Park, Ill. 60130

C. For testing optokinetic reflex

1. Optokinetic Drum
Da-Laur, Inc.
636 Beacon Street
Boston, Mass. 02215

D. Stereoscopic and other instruments for screening various components of vision

Most of these instruments screen for visual acuity, accommodative ability, muscle balance, and color vision. The use of a stereoscopic instrument eliminates the need for large floor space, guarantees proper lighting, and occludes vision of one eye without the child's knowledge, but these advantages should be weighed against the relatively expensive cost of the instruments. It has also been reported that some children are afraid to look into the "box" while others with poor coordination find it difficult to indicate with their hands what they see in the machine. Observation of the child's behavior regarding squinting, blinking, etc., may not be possible with the use of these instruments.

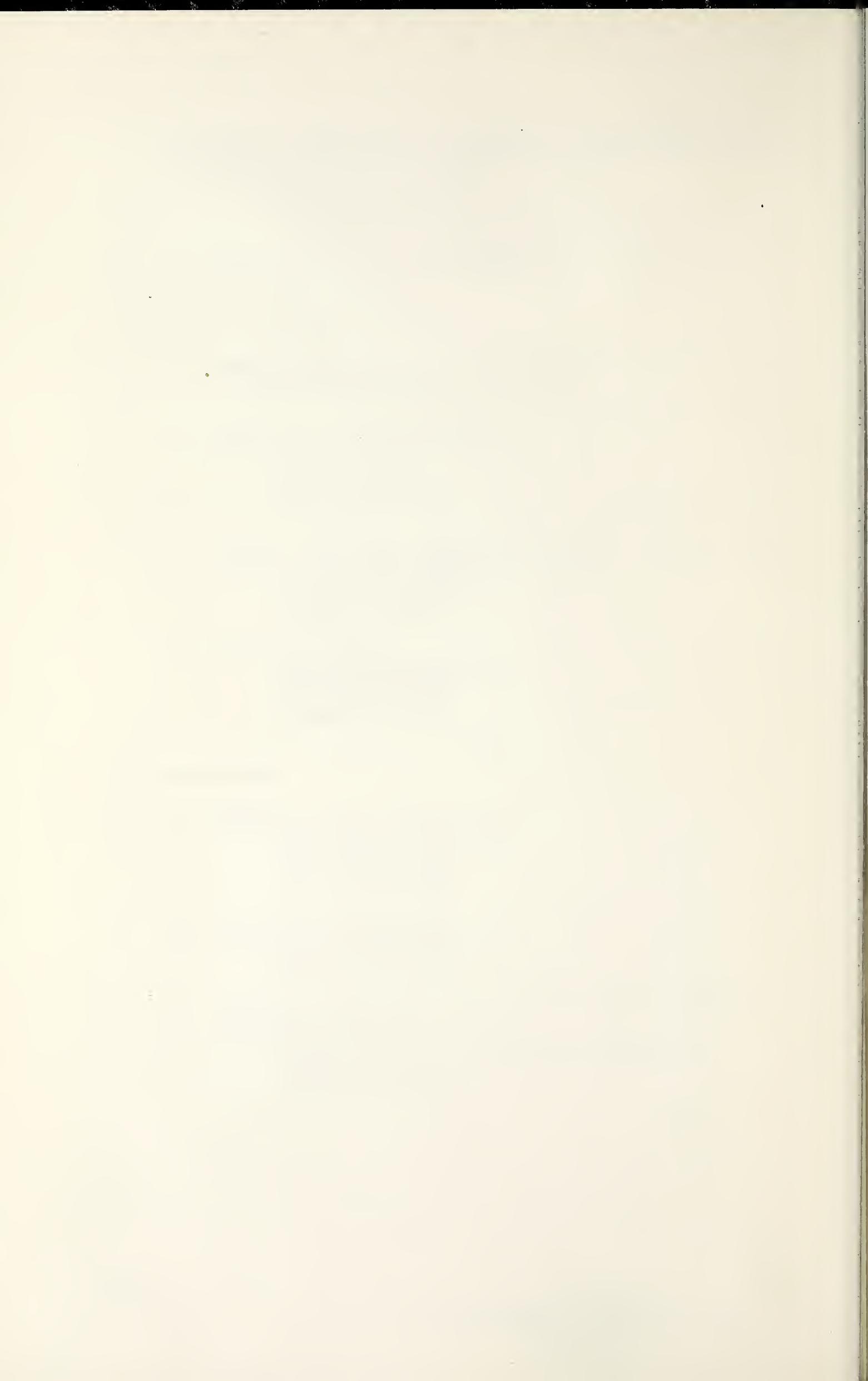
The Michigan Junior Vision Screening Test is used in both the Titmus Vision Screener and the Good-Lite Junior-School Vision Screener.

1. American Optical Child's Vectrograph and Project-O-Chart (*Children's Slides available*)
American Optical Company
14 Mechanic Street
Southbridge, Mass. 01550
2. Bausch and Lomb School Vision Tester
Bausch & Lomb
635 St. Paul Street
Rochester, N.Y. 14602
3. California Clown Test (Do-As-I-Do Vision Test)
Patented but not yet available commercially.
4. Gool-Lite Junior School Vision Screener
Good-Lite Company
7426 W. Madison Street
Forest Park, Ill. 60130
5. Keystone Telebinocular (*Keystone Preschool Test used for young children with the No. 46 Telebinocular available*)
Keystone View Company
Meadville, Pa. 16335
6. Titmus Vision Tester
Titmus Optical Company, Inc.
1015 Commerce Street
Petersburg, Va. 23803

E. Miscellaneous

1. Michigan Pre-school Training Cards
Titmus Optical Company, Inc.
1015 Commerce Street
Petersburg, Va. 23803
2. Source C Macbeth Easel Lamp
Macbeth Daylighting Company
Newburgh, N.Y. 12550
3. Cover and Window Cards (*for exposing one letter or symbol at a time in vision screening*)
National Society for the Prevention of Blindness, Inc.
79 Madison Avenue
New York, N.Y. 10016









c. 3

RE62 Lin-Fu, Jane S.
L645 VISION SCREENING OF CHILDREN.
(1971)

Date Due				
12/30/74				

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RE62
L645 Lin-Fu, Jane S.

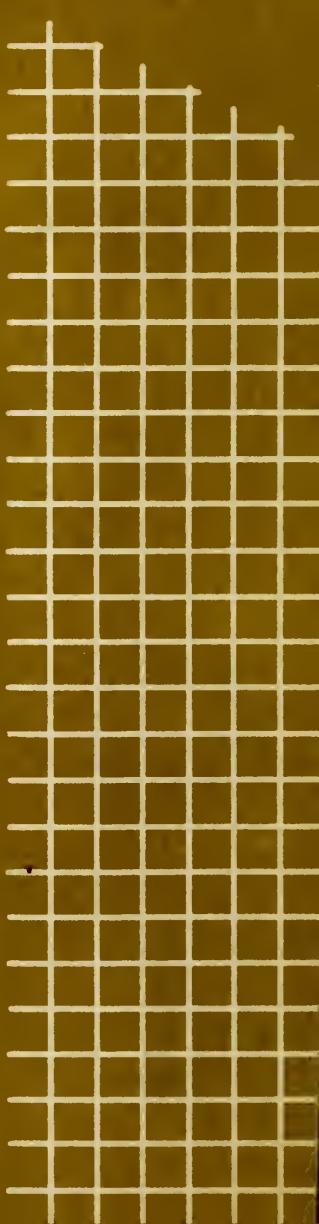
AUTHOR

VISION SCREENING OF CHILDREN.

TITLE

(1971)

DATE DUE	BORROWER'S NAME
12/30/74	Pearl Newman



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